Wilson Bull., 92(2), 1980, pp. 221–228

THE INFLUENCE OF AGE ON THE BREEDING BIOLOGY OF RING-BILLED GULLS

Gerard T. Haymes and Hans Blokpoel

The influence of age on breeding parameters has been studied for many bird species. In larids, breeding parameters that have been examined include: (1) date of laying (e.g., in the Black-legged Kittiwakes [*Rissa tridactyla*], Coulson and White 1958); (2) clutch-size (e.g., in Arctic Terns [*Sterna paradisaea*], Coulson and Horobin 1976) and (3) breeding success (e.g., in Herring Gulls [*Larus argentatus*], Chabrzyk and Coulson 1976). In Ring-billed Gulls (*Larus delawarensis*), Ryder (1975) showed a general relationship between plumage, as a gross measure of age, and some reproductive parameters.

This paper examines the influence of age on: (1) the date of clutch initiation, (2) nest location, (3) clutch-size, and (4) hatching success of Ring-billed Gulls. It also examines the influence of age on each of the last 3 parameters for early nesters and for late nesters, separately.

STUDY AREA

This study took place in 1977 on the Eastern Headland (Leslie Spit) of the Toronto Outer Harbour, near Toronto, Ontario, Canada. Leslie Spit is a man-made peninsula of clean fill and dredged spoil extending about 5 km into Lake Ontario. The area, and its rapid colonization by larids were described by Blokpoel and Fetterolf (1978). In 1977 there were about 20,000 pairs of Ring-billed Gulls nesting in 4 sub-colonies separated by narrow inlets. The 2 largest of these sub-colonies were used in this study. No banding has been conducted on the Eastern Headland, but many banded birds that had been banded elsewhere were present.

METHODS AND MATERIALS

Through systematic searches of the 2 sub-colonies, nests of banded birds were located and marked with numbered stakes. The band numbers were obtained by trapping birds on the nest with walk-in traps similar to those described by Weaver and Kadlec (1970) (N = 134) or by reading them with binoculars (N = 30).

Of the 164 banded birds found nesting in the 2 sub-colonies, 151 had been banded as chicks and their exact ages could be determined. For the 13 birds that had been banded during a year other than their hatching year, only minimum ages could be determined. Of those birds 10 could be included in the oldest age category that we used in this study (≥7-years-old). The remaining 3 birds were not used.

All eggs in each staked nest were numbered and nests were examined every second or third day, weather permitting, until hatching. For nests that already contained eggs when we first located them, dates of clutch initiation were determined from hatching dates using an incubation period of 27 days. We plotted nest locations on maps from which distance between nests and the center of the colony were then calculated.

Data for some of the nests were incomplete due to a number of minor problems, such as

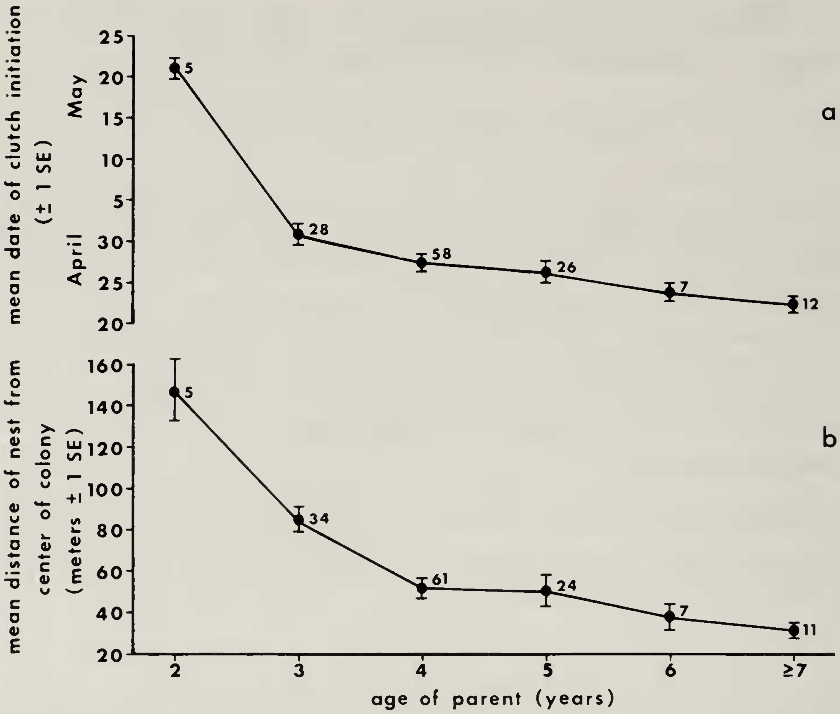

FIG. 1. (a) The mean date of clutch initiation and (b) the mean distance of nests from the center of the colony for Ring-billed Gulls of known age at the Eastern Headland, 1977. The numbers on the figures refer to the number of nests.

fading of the numbers on the stakes. As a result sample sizes vary slightly throughout the analyses. As the results for the 2 sub-colonies were not significantly different in any respect, data for the 2 then were pooled to increase sample sizes.

RESULTS

In 1977 egg-laying on Leslie Spit began before 15 April (estimated at 10 April) and continued into July. The date when the first egg was laid in a nest (i.e., date of clutch initiation) by a banded bird was 17 April.

The mean date of clutch initiation for each of 6 age categories of Ring-billed Gulls is shown in Fig. 1a. The mean date of clutch initiation was consistently earlier as age increased. There was a significant correlation between age and date of clutch initiation ($r_s = 0.479, P < 0.001$) (Spearman rank correlation coefficient).

Coulson (1968) showed that kittiwakes, nesting near the center of the

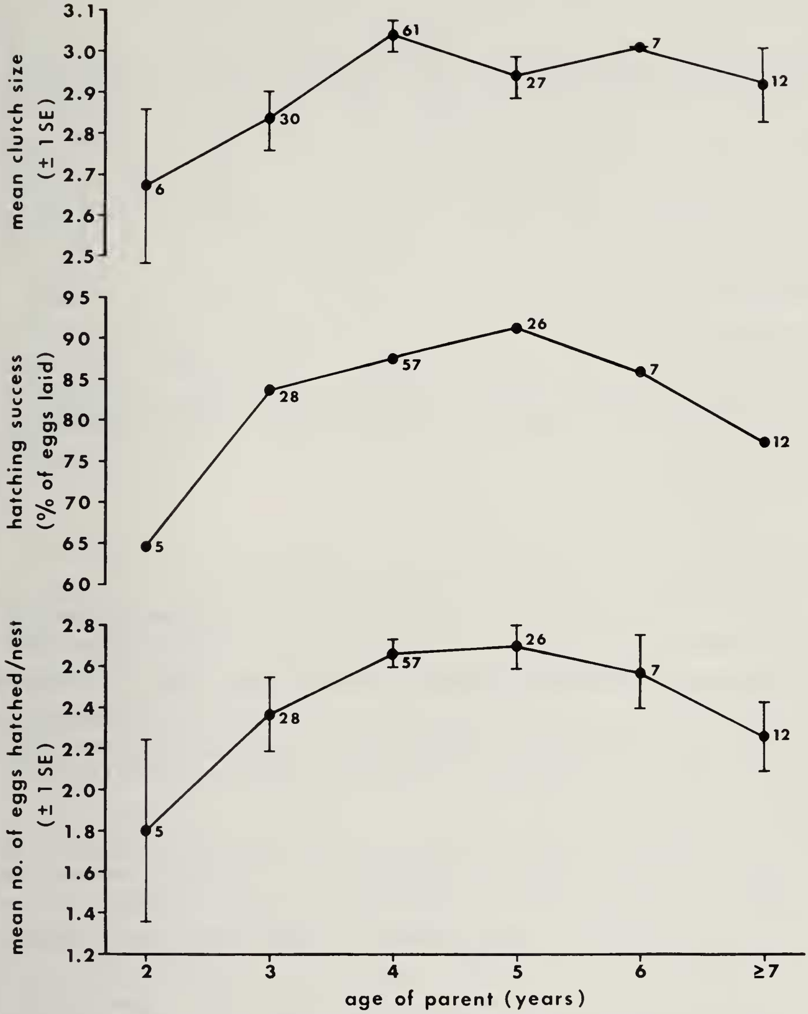

FIG. 2. (a) Mean clutch-size, (b) hatching success and (c) the mean number of eggs hatched per nest for Ring-billed Gulls of known age at the Eastern Headland, 1977. The numbers on the figures refer to the number of nests.

colony, laid eggs earlier in the season than gulls on the periphery. Consequently, we estimated the center of the colony as the geometric center of the clutches that were initiated by banded birds on or before 21 April (N = 14 and N = 11 in the 2 sub-colonies). The mean distance between nests and the center of the colony decreased as parental age increased

TABLE 1

NEST LOCATION, MEAN CLUTCH-SIZE AND HATCHING SUCCESS FOR YOUNG AND OLD RING-BILLED GULLS NESTING EARLY AND LATE IN THE SEASON, AT THE EASTERN HEADLAND, 1977

	Early[a]		Late[a]	
	≤3 years	≥4 years	≤3 years	≥4 years
Number of nests	9	76	23	13
Percent central (≤50 m of center)	11.1%[b]	72.4%[b,c]	13.0%	15.4%[c]
Mean clutch-size (±1 SE)	2.88 ± 0.10	2.95 ± 0.03	2.78 ± 0.09[d]	3.00 ± 0.00[d]
Hatching success	96.2%[e]	88.4%	73.4%[e]	84.6%

[a] See text.
[b] $P < 0.001$ (Fisher test).
[c] $P < 0.001$ (Fisher test).
[d] $P < 0.1$ (Fisher test).
[e] $P < 0.01$ (Fisher test).

(Fig. 1b). The Spearman rank correlation coefficient between age and distance from the center of the colony was significant ($r_s = 0.524$, $P < 0.001$).

The clutch-size of Ring-billed Gulls of known age at Leslie Spit ranged from 2–5 eggs. The mean clutch-size increased with parental age up to age 4 and then levelled off, or slightly declined (Fig. 2a). From ages 2–4, inclusive, there was a significant correlation coefficient ($r_s = 0.309$, $P < 0.005$).

The hatching success (the number of hatched eggs, expressed as the percentage of the total number of eggs laid) increased with parental age from 64.3% for 2-year-old birds to 90.9% for 5-year-old birds and then decreased to 77.1% for ≥7-year-old birds (Fig. 2b). The increase in hatching success with parental age from ages 2–5 was significant ($P < 0.02$, linear trend for proportions, Snedecor and Cochran 1967). The difference in hatching success between 5-year-old birds and ≥7-year-old birds was not statistically significant (NS, 2 × 2 χ^2-test with Yates correction for continuity, Siegel 1956).

The number of eggs hatched per nest showed a pattern similar to that of hatching success for the 6 age categories (Fig. 2c). There was a significant correlation between this measure of reproductive success and age from the 2-year-old through the 5-year-old categories ($r_s = 0.216$, $P < 0.025$). The decline in the number of eggs hatched per nest from ages 5–≥7 was significant ($r_s = -0.333$, $P < 0.05$).

Table 1 indicates the influence of parental age (≤3-years-old, ≥4-years-old) on nest location, clutch-size and hatching success during 2 different time periods. Clutch initiation dates were partitioned into an early period (on or before 1 May, the date when 75% of all banded birds had initiated clutches) and a late period (after 1 May). Only those nests for which information on all 4 parameters was available were used in this analysis.

In the early period the proportion of old (≥4-year-old) birds nesting centrally (within 50 m, the median distance of all banded birds, of the center of the colony) was significantly higher than that of young birds nesting near the center. In the late period that difference disappeared.

The mean clutch-size of young birds was less than that of old birds in both time periods, but the difference was not statistically significant in either case. The hatching success was similar for old and young birds in the early time period. However, the hatching success of young birds was significantly reduced in the late period, whereas that of old birds did not change significantly.

DISCUSSION

The walk-in traps caused no apparent damage to the incubating birds or their eggs. Captured Ring-billed Gulls returned to incubate their eggs a few minutes after being released.

The high proportion of young birds in our sample is probably not indicative of the actual age distribution within the colony. Although annual banding of Ring-billed Gulls on the Great Lakes has continued since the 1950's, the large banding programs conducted in 1972 and 1973 on the lower Great Lakes partially explain the large number of banded 4- and 5-year-old birds in 1977. In addition, Ludwig (1967) reported that band loss on Ring-billed Gulls becomes common after 5 years wear. Loss of bands, as well as annual adult mortality, explain the absence of banded birds more than 11 years old and the small proportion of banded birds over 6 years old. The oldest band read during this study was worn by the bird for 11 years. Several bands showed extensive wear, but only 2 bands on trapped birds were unreadable.

In this study we knew the age of only 1 bird per nest. A close correlation between the age of the male and that of the female in breeding pairs has been shown for the kittiwake (Coulson 1966) and the Arctic Tern (Coulson and Horobin 1976) and a weaker correlation was found for the Red-billed Gull, *Larus novaehollandiae*, (Mills 1973). We assumed that Ring-billed Gulls tend to have mates of about the same age. That assumption appears to be justified by the strong correlations we found between the age of 1 parent and several breeding parameters.

At Leslie Spit in 1977, Ring-billed Gulls consistently nested earlier in the season and closer to the center of the colony as age increased. These results are consistent with those of Ryder (1975) who found that pairs of Ring-billed Gulls containing 1 or 2 birds with immature plumage laid eggs late in the season and close to the periphery of the colony.

In studies of the influence of age on the breeding success of other larids, clutch-size and hatching success were found to increase with age (Coulson and White 1958, Chabrzyk and Coulson 1976). Our data showed that mean clutch-size of Ring-billed Gulls increases with parental age up to age 4 and then levels off. Hatching success and the number of eggs hatched per nest increased with parental age up to age 5. However, our data demonstrated a decline in hatching success and in the number of eggs hatched per nest in older (≥6-year-old) birds. To the best of our knowledge, a decline in reproductive success in old birds has not been reported for other larids. The data of Coulson and Horobin (1976) suggested a decline in clutch-size and egg volume in old (≥8-year-old) Arctic Terns, but no corresponding decline in breeding success.

The influence of age on the breeding parameters of gulls in an early and late laying period were addressed in this study. Young birds were found to nest away from the center of the colony regardless of the time of clutch initiation. This observed behavior may indicate an inability of young birds to establish territories among older birds and/or a difference in the time of first arrival on the colony. Old birds while nesting centrally early in the season, nest farther from the center late in the season, probably due to a lack of central nest-sites at that time.

Coulson and White (1961) found that young kittiwakes laid smaller clutches than did older birds and that birds of all ages laid smaller clutches late in the season. In our study the mean clutch-size of young Ring-billed Gulls was slightly below that of old birds, but only the mean clutch-size of young Ring-billed Gulls declined slightly in the late period.

The hatching success of early-nesting, young Ring-billed Gulls was as high as that of early-nesting old birds. Hatching success of young birds decreased significantly in the late period, whereas that of older birds did not change substantially. The reduction in hatching success in late-nesting young birds suggests that they were perhaps less able to cope with the problems of laying late than were older, more experienced breeders. Such problems may have included low density of breeding pairs, lack of synchrony (Parsons 1975, 1976), and increased human pressure (hikers, boaters, etc.) as the season progressed.

SUMMARY

The influence of parental age on the breeding biology of Ring-billed Gulls was studied on the Eastern Headland of the Toronto Outer Harbour in 1977. Ring-billed Gulls nested consistently earlier in the season and closer to the center of the colony as age increased. Mean

clutch-size increased with parental age up to age 4 and then levelled off. Hatching success and the number of eggs hatched per nest increased with parental age up to age 5. The data suggest a decline in hatching success and the number of eggs hatched per nest for birds that are more than 5 years old.

Young (2- and 3-year-old) Ring-billed Gulls tended to nest away from the center of the colony regardless of the date of clutch initiation. The mean clutch-size of young birds was slightly below that of old (≥4-year-old) Ring-billed Gulls both early and late in the season. Early in the season the hatching success of young birds was similar to that of old birds. Hatching success of young birds, but not of old birds, declined substantially in the late period.

ACKNOWLEDGMENTS

The Toronto Harbour Commission kindly allowed us to work on the Eastern Headland and supplied the field accommodation. We thank the following persons and institution for permission to use their banding data: A. Bunker, A. R. Clark, C. H. Richards and W. E. Southern, and the Long Point Bird Observatory whose banders included M. S. W. Bradstreet, H. Krug, R. Rogers, R. B. Sutherland, R. R. Tasker and D. V. Weseloh. K. Newell of the Population and Survey Division, Canadian Wildlife Service supplied the banding data. R. J. Prins assisted in the field. P. Angehrn drew the figures. H. Beznaczuk and G. E. J. Smith assisted with the statistical analysis. S. G. Curtis, J. E. Bryant and R. D. Morris commented on the manuscript.

LITERATURE CITED

Blokpoel, H. and P. M. Fetterolf. 1978. Colonization by gulls and terns of the Eastern Headland, Toronto Outer Harbour. Bird-Banding 49:59–65.

Chabrzyk, G. and J. C. Coulson. 1976. Survival and recruitment in the Herring Gull, *Larus argentatus*. J. Anim. Ecol. 45:187–203.

Coulson, J. C. 1966. The influence of the pair bond and age on the breeding biology of the Kittiwake Gull, *Rissa tridactyla*. J. Anim. Ecol. 35:269–279.

———. 1968. Differences in the quality of birds nesting in the centre and on the edges of a colony. Nature 217:478–479.

——— and J. Horobin. 1976. Influence of age on breeding biology and survival of Arctic Tern, *Sterna paradisaea*. J. Zool. (London) 178:247–260.

——— and E. White. 1958. The effect of age on the breeding biology of the Kittiwake, *Rissa tridactyla*. Ibis 100:40–51.

——— and ———. 1961. An analysis of the factors influencing the clutch size of the Kittiwake. Proc. Zool. Soc. Lond. 136:207–217.

Ludwig, J. P. 1967. Band loss—its effect on banding data and apparent survivorship in the Ring-billed Gull population of the Great Lakes. Bird-Banding 38:309–323.

Mills, J. A. 1973. The influence of age and pair-bond on the breeding biology of the Red-billed Gull, *Larus novaehollandia scopulinus*. J. Anim. Ecol. 42:147–162.

Parsons, J. 1975. Seasonal variation in the breeding success of the Herring Gull: an experimental approach to prefledging success. J. Anim. Ecol. 44:553–573.

———. 1976. Nesting density and breeding success in the Herring Gull, *Larus argentatus*. Ibis 118:537–546.

Ryder, J. P. 1975. Egg-laying, egg size and success in relation to immature-mature plumage of Ring-billed Gulls. Wilson Bull. 87:534–542.

Siegel, S. 1956. Nonparametric statistics for the behavioral sciences. McGraw-Hill Book Co., New York, New York.

SNEDECOR, G. AND W. G. COCHRAN. 1967. Statistical methods. Iowa State Univ. Press, Ames, Iowa.

WEAVER, D. K. AND J. A. KADLEC. 1970. A method for trapping breeding adult gulls. Bird-Banding 41:28–31.

ONTARIO HYDRO, BIOLOGICAL RESEARCH SECTION, RC-15, 800 KIPLING AVE., TORONTO, ONTARIO M8Z 5S4, CANADA AND CANADIAN WILDLIFE SERVICE, ONTARIO REGION, 2721 HIGHWAY 31, OTTAWA, ONTARIO K1G 3Z7, CANADA. ACCEPTED 12 JAN. 1979.